12-2-89

# EFFECTS OF BRINE WITHDRAWALS ON THE HYDROLOGIC SYSTEM OF THE BONNEVILLE SALT FLATS AREA, UTAH

PROBLEM:

The U. S. Bureau of Land Management needs scientific information in order to determine the potential effects of development of mineral resources, primarily brine withdrawals, in the vicinity of the Bonneville Salt Flats (fig. 1). In the past 10 years, substantial climatic variations have imposed measurable stresses on the hydrologic system. One impact of the climatic variations and development has been a measured reduction in salt thickness in the area which includes Bonneville Salt Flats State Park and Bonneville Speedway. There is a need to evaluate the source, timing, magnitude, and extent of climatic stresses, as well as the stresses of continuing withdrawal of brine; apply new technology where appropriate; and update previous hydrologic studies in the area.

OBJECTIVES:

1.--Document changes in the hydrologic system since Lines (1979).

2.--Establish a network to monitor future changes in water levels, water chemistry, and salt thickness in the Bonneville Salt Flats.

3.--Assess the impacts of current and projected brine withdrawals, other man-induced variations, and climatic changes on the hydrologic system. This includes impacts on ground-water chemistry, water levels, and salt deposits in the Bonneville Salt Flats.

4.--Assess the potential for removal of salts from the salt flats area via wind-driven ponds.

APPROACH:

A detailed plan of study will be prepared during the first two months of the project. The plan will be reviewed by the BLM to insure that proposed activities will provide the BLM with the information they require.

LANDSAT and other aerial photography of the Salt Flats area will be obtained and reviewed to define the formation and movement of ponds.

Observation wells that were drilled during the Lines (1979) study and still exist will be located if possible. Water levels in these wells will be measured monthly to provide a documented seasonal record that can be used in model calibration and determining the direction of ground-water flow. Samples of brine will also be collected from the wells monthly and analyzed for density and major inorganic constituents.

The three dimensional solute transport model, HST, will be used to prepare a very rough, preliminary simulation of the flow system. Generalized assumptions will be used to identify the types ard locations of data needs.

New observation wells will be drilled on and adjacent to the Salt Flats. Cores will be collected and analyzed for mineralogical content. Salt thickness and water levels will be measured, and samples of brine will be collected and analyzed. Nested wells (adjacent wells completed at different depths) will be part of the drilling plan in order to determine vertical variations in water level and density. The existing and new wells will comprise the comprehensive observation well network.

A production well (8 inches or larger) and several nearby observation wells will be drilled and an aquifer test will be conducted. Aquifer tests results from Lines (1979) and others since 1979 will be reviewed.

The location of sediments deposited behind man-made barriers (I-15, ditch embankments) will be mapped.

Data collected by private and public sources since Lines (1979) will be gathered. Reilly Industries will be contacted and requested to provide all brine withdrawal, water level, chemical analyses, meterological, and other pertinent data for the past 12 years. The data will be compliled into a format necessary for statistical and computer analysis. All pertinent data will be entered into the Geographic Information System ARC/1NFO.

The water and salt balances from Lines (1979) will be reviewed and revised. The geochemical flow paths and reactions along these paths will be estimated to describe processes that may increase and decrease the salt thickness and area. The geochemical model, SNORM, will be applied to simulate the geochemical reactions.

A variable density flow model will be constructed for the Salt Flats area to simulate the flow rates, flow paths, and chemical concentrations of selected constituents. Climatic and Newfoundland Evaporation Stage and chemical data will be imposed as stresses on the hydrologic system. Specific attention will be paid to simulating the effects of precipitation since 1960 on the hydrologic system in the Salt Flats area. The 3-D solute transport model by Kipp (1987), HST, and 2-D cross-sectional model by Konikow may be used. Final selection of the model(s) to be used will be made after a review of existing, appropropriate, published, and documented models.

The model(s) will be used to simulate future water level and ground-water chemistry using alternative senarios supplied by Reilly and BLM.

Wells and surface water that will be useful for monitoring changes in the future will be identified.

PRODUCTS:

Progress reports will be prepared quarterly. A report documenting the results of the study, with maps and tables of data, will be prepared and published in a formal U. S. Geological Survey series publication. The final report will be approved for publication by December 31, 1992.

PERSONNEL AND FUNDING:

(See attached sheet)

REFERENCES CITED

Kipp, K.L., Jr., 1987, HST3D: A Computer code for simulation of heat and solute transport in three-dimensional ground-water flow systems: U. S. Geological Survey Water-Resources Investigations Report 86-4095, 515 p.

Konikow, L. F., and Bredehoeft, J. D., 1978, Computer model of two-dimensional solute transport and dispersion in ground water: U. S. Geological Survey Techniques of Water-Resources Investigations, Book 7, Chapter C2, 90 p.

Lines, G. C., 1979, Hydrology and Surface Morphology of the Bonneville Salt Flats and Pilot Valley Playa, Utah: U. S. Geological Survey Water Supply Paper 2057, 107 p.

## Personnel anc Funding

| | FY 1990 | FY 1991 | FY 1992 | Totals |
|---|---|---|---|---|
| Hydrologist | 61C00 | 62C00 | 64C00 | 187000 |
| Hydrologic Tech | 3CC0C | 31C00 | 19C00 | 80000 |
| Vehicles/Per diem | 16C0C | 18C00 | 4000 | 38000 |
| Equipment/Supplies | 3C0C | 4C00 | 2000 | 9000 |
| Chemical Analyses | 5C0C | 15000 | 5000 | 25000 |
| Drilling | | 5CC00 | | 50000 |
| Publications | | | 5C00 | 5000 |
| TCTALS: | 115C00 | 18CC00 | 99000 | 394C00 |

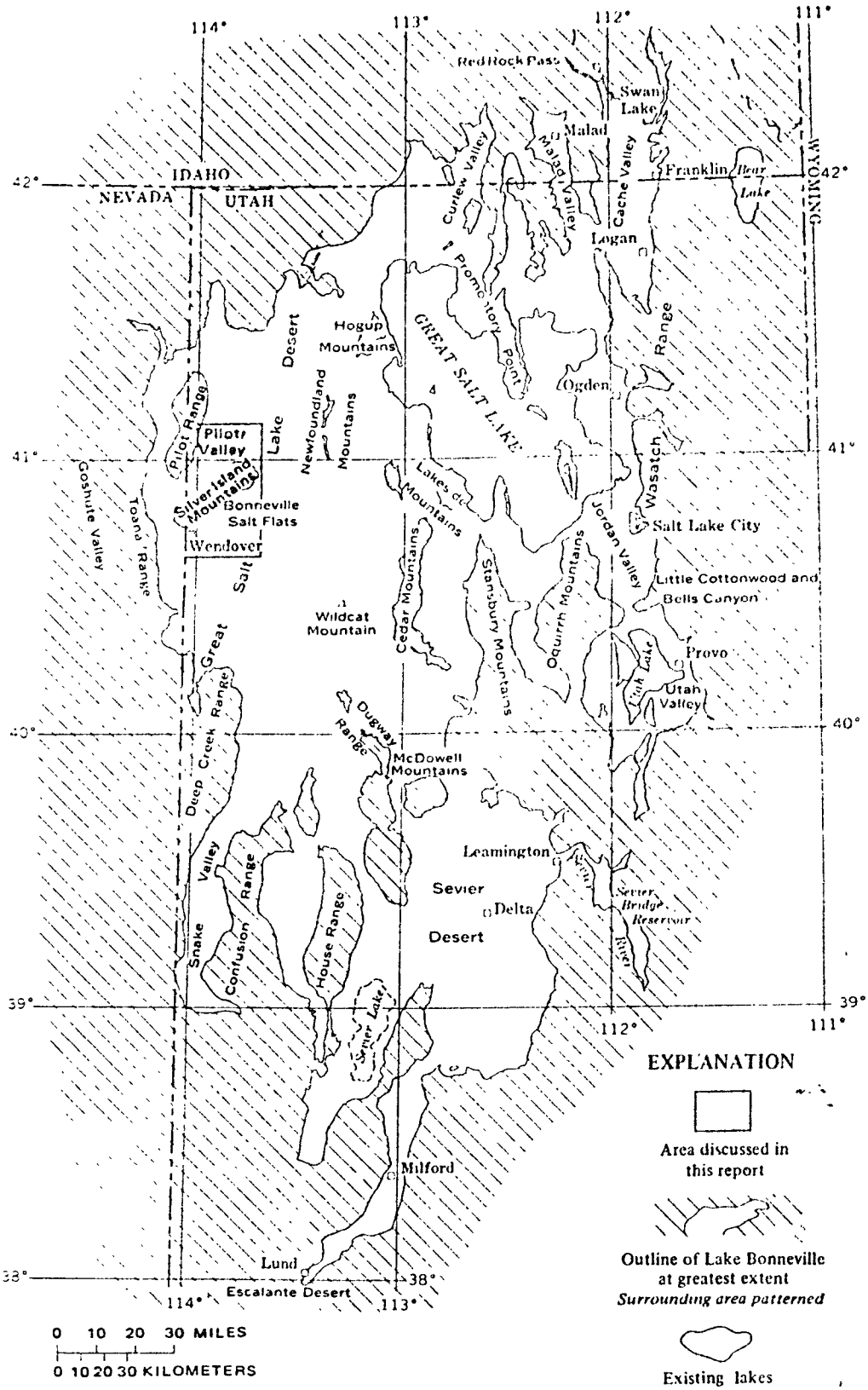


FIGURE 1.—Map of northern Utah and adjacent areas showing the study area, the physiography, and the extent of ancient Lake Bonneville (modified from Crittenden, 1963, fig. 1).